PERFORMANCE OF DOLOMITE WITH DIFFERENT PERCENTAGE AS SAND REPLACEMENT IN FOAM CONCRETE

NUR HAZWANI BINTI MAT ROPI

B. ENG (HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

_____

(Student's Signature)

Full Name : Nur Hazwani Binti Mat Ropi

ID Number : AA15259

Date : 29 May 2019

PERFORMANCE OF DOLOMITE WITH DIFFERENT PERCENTAGE AS SAND REPLACEMENT IN FOAM CONCRETE

NUR HAZWANI BINTI MAT ROPI

Thesis submitted in partial fulfillment of the requirements
for the award of the
B.Eng (Hons.) Civil Engineering

Faculty of Civil Engineering & Earth Resources

UNIVERSITI MALAYSIA PAHANG

MAY 2019

ACKNOWLEDGEMENTS

First and foremost, I would like to thank God for His never-ending grace, mercy, and provision during what ended up being one of the toughest times of my life. Special appreciation goes to my supervisor, Mr. Mohd Arif Bin Sulaiman for his supervision and content support. His invaluable help of constructive comments and suggestions throughout the experimental and study works have contributed to the success of this research.

I would also like to thank my academic advisor Mrs. Wafty Binti Abd Rahman for her positive supports and faiths in me throughout my study. Also forward my full gratefulness to Universiti Malaysia Pahang (UMP), and all of the staffs in the Faculty of Civil Engineering & Earth Resources for providing good facilities and the assistance during my study. Also no forgetting to technician in Concrete Laboratory that always help me to finish my lab work. Sincere thanks to all my friends and everybody for their helps and moral support during my study.

Last but not least, my deepest gratitude goes to my beloved parents Mr. Mat Ropi Bin Abdullah and my late mother Mrs. Mek Limah Binti Abdullah and also to my family for their endless love, prayers and encouragement. To those who indirectly contributed in this research, your kindness means a lot to me. Thank you very much.

ABSTRAK

Kajian ini dijalankan bagi mengkaji prestasi dolomit dengan peratusan yang berbeza sebagai penggantian pasir dalam pembuatan konkrit berbusa untuk meningkatkan kekuatan mampatan dan mengurangkan penggunaan pasir dalam pembinaan dan dalam masa yang sama dapat mengurangkan pencemaran sungai. Penghasilan campuran konkrit berbusa bergantung kepada jenis bahan, jenis ejen busa dan reka bentuk campuran konkrit. Objektif kajian ini dijalankan adalah untuk mengkaji sifat fizikal (bentuk, saiz, kandungan kelodak) dan komposisi kimia pada dolomit dan juga untuk menentukan kekuatan mampatan konkrit busa. Ciri-ciri fizikal dan kimia pada dolomit telah dikaji dengan menggunakan mikroskop, ujian lumpur, analysis menggunakan ayak, Analisis Pendafloue Sinar-X (XRF), Mikroskop Imbasan Elektron (SEM) dan Analisis Serakan Sinar-X (XRD). Kadar peratusan dolomit yang digunakan adalah 10%, 20%, 30%, dan 40% sementara sampel untuk 0% dolomit digunakan sebagai sampel kawalan. Jumlah specimen adalah sebanyak 45 kiub yang menggunakan acuan bentuk kiub bersaiz 100mm x 100mm x 100mm dengan menggunakan dolomit yang melepasi ayak saiz 600micro dan kepadatan untuk setiap $100mm^3$ ialah $1600kg/m^{3.}$ Nisbah air busa ialah 1:25. Ujian untuk menentukan kekuatan mampatan konkrit busa dijalankan untuk 7 hari, 14 hari dan 28 hari semasa proses pengawetan di dalam air. Keputusan menunjukkan bahawa 30% daripada dolomit telah meningkatkan kekuatan mampatan konkrit busa. Hasil yang diperolehi dianalisis dan sifat fizikal dan kimia dolomit direkod.

ABSTRACT

This paper investigate the performance of dolomite with different percentage as sand replacement in production of foam concrete to increase the compressive strength and reduce the uses of sand in construction while reducing river pollution. The production of foam concrete mix depend on material section, selected foaming agent and mixture design strategies. The objective of this study are observed the physical properties (shape, size, silt content) and chemical composition of dolomite and also to determine the compressive strength of foam concrete. The physical and chemical properties of the dolomite was tasted using microscope, silt test, sieve analysis, X-Ray Fluorescence (XRF), Scanning Electron Microscopy (SEM) and X-Ray Diffraction Analysis (XRD). The percentage rate of dolomite are 10%, 20%, 30% and 40% meanwhile the sample for 0% of dolomite was used as the control sample. The total of specimen are 45 cubes using form cube size 100mm x 100mm x 100mm with using dolomite that passing through 600micron sieve size and the density for $100mm^3$ is $1600kg/m^3$. Foam water ratio is 1:25. The test for determined the compressive strength of foam concrete was conducted for 7 days, 14 days and 28 days during curing processed. Results indicate that 30% of dolomite significantly improved the compressive strength of foam concrete. The obtained results are analysed and the other physical and chemical properties of dolomite are recorded.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AAC	Autoclaved Aerated Concrete
CLSM	Cement Lime Sand Mortar
LWC	Lightweight Concrete
NWC	Normal Weight Concrete
SEM	Scanning Electron Microscopy
XRD	X-Ray Diffraction
XRF	X-Ray Fluorescence

CHAPTER 1

INTRODUCTION

1.1 Introduction

In the construction industry, especially in the construction of housing is the longest industry in the world. The need of shelter makes people strive to provide shelters or be known as house. At the beginning of human life, construction of houses only uses the materials found around their homes. Among them is by using natural resources that are readily available and can continue to be used, such as wood. While resident in a limited wood resources, they began to build a house using building materials such as sludge which is the basis of concrete development.

Concrete is a building material that has been widely used in the construction industry. History record show that concrete has begun to be used as a building material as early as the 1850s. This is evident when older Egyptians use unpaved gypsum ash as a cement material, while the Greeks and Roms have long used the limestone ash in the preparation of concrete. This can be seen at the construction of the Coliseum in Rome and Pont du Gard near Nimes which remains to this day (Neville, 1994).

The development of concrete technology around the world has shown how concrete-based building materials have been take over building materials sourced from natural materials. This change is due to the strength and durability of concrete is better than other building materials that are important features of a building. The main basic of concrete preparation is mixing of cement, aggregate and water mixtures. The use of additives and other materials is also commonly used in concrete mixes to produce high quality concrete or produce specific concrete according to user requirements.

Demand for concrete use in the construction industry which is rapidly expanding to the need for various types of concrete properties to meet its requirements. This

condition makes the concrete industry often produce a variety of new products. This product covers the process of innovation in the use of new raw materials, methods of production and use of chemicals in concrete mixes, producing more economical concrete and diversifying concrete products. Among the interesting concrete innovation process is low lightweight concrete production.

Lightweight concrete initially has been defined as concrete produced using lightweight aggregate to replace ordinary aggregates. The development of lightweight concrete technology has succeeded in producing lightweight concrete without the use of aggregates, which is to use chemicals to produce stable foam in concrete or mortar. Foam concrete is a highly aerated mortar because it mostly no coarse aggregate is used for it production. Foam concrete typically consists of a slurry of cement, sand and water with the foaming agent. Foam concrete is a lightweight concrete which is lighter than conventional concrete. The production of stable foam concrete mix depends on many factors such as selecting of foaming agent, material section and mixture design strategies and production of foam concrete.

According to the draft International Standard Model Code for Concrete Construction (1977), has classified lightweight concrete having a density of between 1200 kg/m^3 to 2000 kg/m^3. However, the use of foam in lightweight concrete makes lightweight concrete can be provided with a density as low as 300 kg/m^3. Generally, ordinary concrete is provided with a density of 2240 kg/m^3 to 2400 kg/m^3.

Dolomite can be defined as natural aggregates consisting of one or more minerals that are sedimentary rocks resulting from the deposition of river or sea that lasted for millions of years. The raw dolomite is extracted in Chuping, in the state of Perlis, Malaysia. Dolomite as a mineral has very few uses. Dolomite is used as a source of magnesia (MgO), a feed additive for livestock, a sintering agent and flux in metal processing, and as an ingredient in the production of glass, brick, and ceramics. According to Zainal H, Director Department of Mineral and Geoscience Malaysia said, “If the dolomite is processed into magnesia, the extract is useful for reducing the rate of chemical contamination radiation, durable and light brick, furniture, tiles and concrete”. It is recently used in 2011. Dolomite will use as a replacement a part of sand in foam concrete. The smaller size of dolomite can be uses as a filler in foam concrete.

1.2 Problem Statement

In this modern age, development is growing for fulfilling population capacity. Low density concrete has some special features as building materials. One of the important features of the concrete is lighter. With low density make this concrete lighter than ordinary concrete. In the construction industry the dead load factor is the one of the main factor. Therefore, the reduction of concrete density will reduce the overall weight of building structure.

Lightweight Foam Concrete has low strength compared to normal concrete. Lightweight concrete has strength about $15kN/m^3 – 17.5kN/m^3$ and normal concrete has strength about $21kN/m^3 – 23kN/m^3$, (Wan, 2013). The strength of foam concrete is lower, so the use of foam concrete will decrease. The ways to control Lightweight Foam Concrete is using density. By using different quantities of foamed agent will affect the strength and quality of foamed concrete. The compressive strength of concrete depends on the water to cement ratio, degree of compaction, ratio of cement to aggregate, bond between mortar and aggregate, and grading, shape, strength and size of the aggregate (Abdullahi, 2012).

To increase the strength of foam concrete by using material for filler to fill up the bubble in the concrete. Through this problem, one of the solution suggested is the use of dolomite as a replacement a part of sand. This is because dolomite has a size smaller than sand. Dolomite also have a potential to be used in construction. Besides that, the uses of dolomite can also reduce the uses of sand in construction.

The use of river sand will also increase as well with the development being carried out. This is because sand is one of the main materials in the construction. As reported in the newspaper after an interview people who are living near the river by Nur (2014) has stated that the effects of sand extraction activities among them are presence of dust, river water is getting polluted and lack of clean water supply as show in Figure 1.1. Muaz (2014) an engineer living in the area near the river also said that “before the sand dredging activity, he was dig a well for daily use, but now the water getting dry”. In addition, water strings are also small and river water is also polluted by the effects of this activity.

REFERENCES

Abdullahi. M, (2012). Effect of Aggregate type on Compressive Strength of Concrete. International Journal of Civil and Structure Engineering. Vol. 2, No. 3, PP. 791-800.

Ali J. Hamad, (2014). Materials, Production, Properties and Application of Aerated Lightweight Concrete. International Journal of Materials Science and Engineering. Vol. 2, No. 2, PP. 152-157.

Aswathy.M (2017). Experimental Study on Lightweight Foamed Concrete. International Journal of Civil Engineering and Technology (IJCIET).Vol. 8, No. 8, PP. 1404-1412.

Cho, S.-W. (2013). Effect of silt fines on the durability properties of concrete. Journal of Applied Science and Engineering. Vol.16. PP 425-430. 10.

Ding Y, Ren Q.F., WenChao, (2011). "concrete", Progress of Research on Foam Concrete. PP. 13-15.

F.M. Hossain a, B.Z. Dlugogorski b, E.M. Kennedy b, I.V. Belova a, G.E. Murch (2011). A First-principles study of the electronic, optical and bonding properties in dolomite Computational Materials Science. Volume 50, Issue 3, PP 1037-1042.

Gokul, K. (2017). Industrial Waste Utilization for Foam Concrete. Ph.D. Thesis. Amrita School of Engineering, Amrita University, India.

Gopal Mishra (2011). What is Lightweight Concrete?. The Constructor Civil Engineering Home. https://theconstructor.org/concrete/lightweight-concrete/1670/.

K C Brady, G R A Watts and M R Jones (2001), Specification for foamed Concrete. PR/IS/40/01, TF 3/31.

K. Ramamurthy, E. K. Kunhanandan Nambiar, G. Indu Siva Ranjani, (2011). A Classification of Studies on Properties of Foam Concrete. Cement and Concrete Composite. Vol. 31, No. 6, PP. 388-396.

Mehta, P. K., & Monteiro, P. J. M. (2014). Concrete: microstructure, properties, and materials (4th Ed.). United States of America: McGraw Hill, PP.113 – 119.

Mydin, M.A.O. and Wang, Y.C, (2011). Structural Performance of Lightweight Steel-Foamed Concrete-Steel Composite Walling System under Compression, Thin-Walled Structures, 49(1), PP. 66-76.

Neville, A. M. (2010). Properties of Concrete (4th Ed.). London: Pearson, 10 – 17, 65–71, 83 – 86, 351-353, 598-599, 688.

Neville, A. M., & Brooks, J. J. (2010). Concrete Technology. London, England: Pearson, 23-25.

Nur (2014). Sinar Harian Newspaper. River Pollution cause by Sand Excavation.

Norasyikin bt md. Yusof (2009). Production of foamed concrete with a method of mixing. Bachelor thesis. University Malaysia Serawak. Page 8-9.

Othman, Rokiah & Khairunisa, M & Duraisamy, Youventharan & Mohd Arif, S. (2019). Effect of processed spent bleaching earth content on the compressive strength of foamed concrete. IOP Conference Series: Earth and Environmental Science. 244.

P.A. Shawnim and F.Mohammad (2018). Toner Used in the Development of Foamed Concrete for Structural Use. Journal of Civil Engineering, Science and Technology. Vol. 9, No. 1.

PP, Yalley. (2018). Effect of Sand Fines and Water/Cement Ratio on Concrete Properties. Civil Engineering Research Journal. 4. 10.19080/CERJ.2018.04.555636.

Rameshwar S. Ingalkar, Shrikant M. Harle (2017). Replacement of Natural Sand by Crushed Sand in the Concrete. Landscape Architecture and Regional Planning. Vol. 2, No. 1, 2017, PP 13-22.

Rocco, C.G., and Elices,M., (2009). Effect of Aggregate Shape on the Mechanical Properties of a Simple Concrete, Engineering Fracture Mechanics, 2009, 76(2), PP 286-298.

Wee, Tiong-Huan & Babu Daneti, Saradhi & Tamilselvan, Thangayah. (2011). Effect of water cement ratio on air-void system of foamed concrete and their influence on mechanical properties. Magazine of Concrete Research.

Yerramala, A. (2014). Properties of concrete with eggshell powder as cement replacement. The Indian Concrete Journal, PP. 94–102.